
NASA-02635 (March 2003)
NATIONAL AERONAUTICS NASA
AND SPACE ADMINISTRATION Superseding NASA-02635
(September 1999)

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE CONSTRUCTION

SECTION 02635

STORM SEWERAGE

03/03

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 BEDDING AND BACKFILL
- 1.4 DRAWINGS
- 1.5 PLANS

PART 2 PRODUCTS

- 2.1 BONDING AND SEALING MATERIALS
 - 2.1.1 Bituminous Coating and Sealing
 - 2.1.2 Epoxy Bonding
- 2.2 FILTER MATERIAL
 - 2.2.1 Filter Fabric
 - 2.2.2 Filter Aggregate
- 2.3 MANHOLE AND CATCH-BASIN MATERIALS
 - 2.3.1 Concrete Block and Mortar
 - 2.3.2 Brick and Mortar
- 2.4 CONDUIT PIPING, JOINTS, FITTINGS AND GASKETS
 - 2.4.1 Cast-Iron Soil Pipe (CISP) and Fittings
 - 2.4.2 Cast-Iron Soil Pipe Joints
 - 2.4.3 Ductile-Iron Pipe and Fittings
 - 2.4.4 Ductile-Iron Pipe Joints
 - 2.4.5 Corrugated [Steel Pipe (CMP)] [Aluminum Pipe (CAP)]
 - 2.4.5.1 Metallic-Coated Corrugated Steel Pipe
 - 2.4.5.2 Polymer Precoated Corrugated Steel Pipe
 - 2.4.5.3 Corrugated Aluminum Pipe
 - 2.4.5.4 Metal Pipe Fittings
 - 2.4.5.5 Gaskets and Coupling Bands
 - 2.4.6 Concrete Pipe
 - 2.4.6.1 Nonreinforced Concrete Pipe and Fittings
 - 2.4.6.2 Reinforced Concrete Pipe (RCP)
 - 2.4.6.3 Reinforced Concrete Pressure Pipe (RCPP)
 - 2.4.6.4 Gaskets

- 2.4.6.5 Joint Mortar
- 2.4.7 Vitrified Clay Pipe (VCP)
- 2.4.8 Plastic Piping
 - 2.4.8.1 Acrylonitrile-Butadene-Styrene (ABS) Composite Pipe
 - 2.4.8.2 ABS Composite Pipe Joints
 - 2.4.8.3 Type PSM Poly(Vinyl Chloride) (PVC) Pipe
 - 2.4.8.4 PVC Pipe Joints
- 2.5 FRAMES, COVERS AND GRATINGS
 - 2.5.1 Manhole Frames [, Covers] [, and Gratings]
 - 2.5.2 Catch-Basin Frames and Gratings
 - 2.5.3 Sump Frame and Grating
- 2.6 PRECAST CONCRETE MANHOLES, RISERS AND PRECAST CONCRETE BASE SECTIONS
 - 2.6.1 Manhole Gaskets
 - 2.6.2 Manhole Connectors
- 2.7 MANHOLE AND CATCH-BASIN ACCESS [STEPS] [LADDER]

PART 3 EXECUTION

- 3.1 EXCAVATION AND BACKFILL
- 3.2 GRADING
- 3.3 PIPE INSTALLATION
 - 3.3.1 Pipe Installation
 - 3.3.2 [Cast-Iron] [and] [Ductile-Iron] Pipe Installation
 - 3.3.3 Corrugated Metal Pipe Installation
 - 3.3.4 Reinforced Concrete Pipe Installation
 - 3.3.5 Vitrified Clay Pipe Installation
 - 3.3.6 ABS Composite Plastic Pipe Installation
 - 3.3.7 PVC Plastic Pipe Installation
- 3.4 PIPE BEDDING
 - 3.4.1 Bedding
 - 3.4.2 Trench Pipe Cradle
 - 3.4.3 Concrete Encasement
 - 3.4.4 Compaction
- 3.5 JACKING PIPE
- 3.6 UNDERGROUND STRUCTURES
 - 3.6.1 Structures
 - 3.6.2 Concrete Construction
 - 3.6.3 Invert Channel Installation
- 3.7 STORM SEWER CONNECTIONS AND WYES
- 3.8 FIELD QUALITY CONTROL
 - 3.8.1 Tests
 - 3.8.1.1 Infiltration Test/Exfiltration Test
 - 3.8.1.2 Hydrostatic Test on Watertight Joints
 - 3.8.1.3 Low Pressure Air Test of Conduit
 - 3.8.2 Interior Inspection of Pipe

-- End of Section Table of Contents --

NASA-02635 (March 2003)
NATIONAL AERONAUTICS NASA
AND SPACE ADMINISTRATION Superseding NASA-02635
(September 1999)

SECTION 02635

STORM SEWERAGE
03/03

NOTE: Delete, revise, or add to the text in this
section to cover project requirements. Notes are
for designer information and will not appear in the
final project specification.

This section covers gravity drainage of surface
water in the project site area not associated with
any structure.

Drawing details shall include sizes, conduit
materials, frames and covers, concrete encasement,
and pads.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be
manually edited except to add new references.
References not used in the text will automatically
be deleted from this section of the project
specification.

The publications listed below form a part of this section to the extent
referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 198 (1994) Standard Specification for Joints
for Circular Concrete Sewer and Culvert
Pipe Using Flexible Watertight Gaskets

AASHTO M 288 (1992) Standard Specification for Interim
Geotextile Specification for Highway
Applications

AASHTO M 306 (1990) Standard Specification for Drainage
Structure Castings

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-103 (1988) Concrete Pipe Installation Manual

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110 (1998) Ductile-Iron and Gray-Iron
Fittings, 3 in. Through 48 in. (76 mm
through 1219 mm), for Water Erratum:
October 1999

AWWA C111 (2000) Rubber Gasket Joints for
Ductile-Iron Pressure Pipe and Fittings

AWWA C210 (1992) Liquid Epoxy Coating Systems for
the Interior and Exterior of Steel Water
Pipelines

ASTM INTERNATIONAL (ASTM)

ASTM A 48 (1994; Rev A) Standard Specification for
Gray Iron Castings

ASTM A 48M (1994; Rev A) Standard Specification for
Gray Iron Castings (Metric)

ASTM A 74 (1998) Standard Specification for Cast
Iron Soil Pipe and Fittings

ASTM A 746 (1994) Standard Specification for Ductile
Iron Gravity Sewer Pipe

ASTM A 760 (1995) Standard Specification for
Corrugated Steel Pipe, Metallic-Coated for
Sewers and Drains

ASTM A 762 (1993; Rev A) Standard Specification for
Corrugated Steel Pipe, Polymer Precoated
for Sewers and Drains

ASTM A 798 (1994) Standard Practice for Installing
Factory-Made Corrugated Steel Pipe for
Sewers and Other Applications

ASTM A 849 (1995) Standard Specification for
Post-Applied Coatings, Pavings, and
Linings for Corrugated Steel Sewer and
Drainage Pipe

ASTM B 745/B 745M (1993) Standard Specification for
Corrugated Aluminum Pipe for Sewers and

Drains

ASTM C 12	(1995) Standard Practice for Installing Vitrified Clay Pipe Lines
ASTM C 139	(1995; Rev A) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 14	(1994) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 14M	(1994) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C 270	(2001a) Standard Specification for Mortar for Unit Masonry
ASTM C 32	(1993) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 361	(1990) Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
ASTM C 361M	(1990) Standard Specification for Reinforced Concrete Low-Head Pressure Pipe (Metric)
ASTM C 387	(2000e1) Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete
ASTM C 425	(1991) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(1994) Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 443M	(1994) Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric)
ASTM C 478	(1995) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1995) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 506	(1995) Standard Specification for Reinforced Concrete Arch Culvert, Storm

Drain, and Sewer Pipe

ASTM C 506M	(1995) Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 507	(1995) Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C 507M	(1994) Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 564	(1997) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 700	(1991) Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 76	(1995) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 76M	(1995) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 923	(1994) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 923M	(1994) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)
ASTM C 969	(1994) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 969M	(1994) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
ASTM D 2321	(1989) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2680	(1993) Standard Specification for

Acrylonitrile-Butadene-Styrene (ABS)
Composite Sewer Piping

ASTM D 2855 (1993) Standard Practice for Making
Solvent-Cemented Joints with Poly(Vinyl
Chloride) (PVC) Pipe and Fittings

ASTM D 3034 (1994) Standard Specification for Type PSM
Poly(Vinyl Chloride) (PVC) Sewer Pipe and
Fittings

ASTM D 3212 (1992) Standard Specification for Joints
for Drain and Sewer Plastic Pipes Using
Flexible Elastomeric Seals

ASTM F 1417 (1992) Standard Test Method for
Installation Acceptance of Plastic Gravity
Sewer Lines Using Low Pressure Air

ASTM F 477 (1995) Standard Specification for
Elastomeric Seals (Gaskets) for Joining
Plastic Pipe

ASTM F 794 (1991) Standard Specification for
Poly(Vinyl Chloride) (PVC) Profile Gravity
Sewer Pipe and Fittings Based on
Controlled Inside Diameter

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-F-621 (Rev E) Frames, Covers, Gratings, Steps,
Sump and Catch Basin, Manhole

1.2 SUBMITTALS

**NOTE: Review submittal description (SD) definitions
in Section 01330 SUBMITTAL PROCEDURES and edit the
following list to reflect only the submittals
required for the project. Submittals should be kept
to the minimum required for adequate quality
control. Include a columnar list of appropriate
products and tests beneath each submittal
description.**

The following shall be submitted in accordance with Section 01330 SUBMITTAL
PROCEDURES in sufficient detail to show full compliance with the
specification:

SD-02 Shop Drawings

Coordination Drawings in accordance with paragraph entitled,
"Drawings," of this section.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following:

- Conduit Piping
- Concrete Mortar
- Brick Mortar
- Gaskets
- Compression Joints
- Frames, Covers and Gratings
- Precast Concrete Manholes
- Precast Concrete Base Sections
- Concrete Block
- Brick
- Bituminous Coating
- Cold Bituminous Mastic Sealer

SD-04 Samples

Samples shall be submitted for the following items:

- Conduit Piping
- Gaskets
- Compression Joints
- Frames, Covers and Gratings
- Precast Concrete Manholes
- Precast Concrete Base Sections
- Concrete Block
- Brick
- Bituminous Coating
- Cold Bituminous Mastic Sealer
- Concrete Block

SD-05 Design Data

Mix designs for Concrete shall be submitted in accordance with paragraph entitled, "Concrete Construction," of this section.

SD-06 Test Reports

Test reports shall be submitted in accordance with paragraph entitled, "Tests," of this section.

- Infiltration Test
- Exfiltration Test
- Hydrostatic Test

SD-07 Certificates

Certificates for the following items shall be submitted in accordance with the applicable paragraphs of this section for:

- Conduit Piping

Concrete Mortar
Brick Mortar
Gaskets
Compression Joints
Frames, Covers and Gratings
Precast Concrete Manholes
Precast Concrete Base Sections
Concrete Block
Brick
Bituminous Coating
Cold Bituminous Mastic Sealer

A Work Plan shall be submitted in accordance with paragraph entitled, "Plans," of this section.

Proposed Schedules
Methods
Materials
Equipment

1.3 BEDDING AND BACKFILL

[Bedding and backfill shall be clean native soil.] [Bedding and backfill shall conform to Section 02225 EXCAVATION, BACKFILLING, AND COMPACTING FOR UTILITIES.]

1.4 DRAWINGS

Contractor shall submit Coordination Drawings interferences for construction. Details of catch basins and manholes shall be shown with proper elevations.

1.5 PLANS

A Work Plan shall be submitted when sewer flow is to be interrupted, noting Proposed Schedules, Methods, Materials and Equipment.

PART 2 PRODUCTS

2.1 BONDING AND SEALING MATERIALS

2.1.1 Bituminous Coating and Sealing

Coating shall be in accordance with ASTM A 849.

Coating shall be in accordance with ASTM A 849, when using materials previously coal-tar coated and for each uncoated ferrous piece used underground.

Cold Bituminous Mastic Sealer shall be in accordance with ASTM A 849 [trowel] [_____] consistency.

2.1.2 Epoxy Bonding

Epoxy adhesive shall be in accordance with AWWA C210.

2.2 FILTER MATERIAL

2.2.1 Filter Fabric

Fabric shall be in accordance with AASHTO M 288, and be water pervious, made of [polyester] [_____] materials.

2.2.2 Filter Aggregate

Aggregate shall be clean [gravel] [sand] [_____] free from organic materials, clay, [_____] , or other deleterious materials, graded to the following minimal limits:

SIEVE SIZE	PERCENT PASSING
4.75 millimeter [_____]	No. 4 [_____] to [_____]
	15 to 30

2.3 MANHOLE AND CATCH-BASIN MATERIALS

Water, for use with concrete block and brick, shall be clean and potable.

2.3.1 Concrete Block and Mortar

Concrete block shall be in accordance with ASTM C 139.

Concrete Mortar shall be in accordance with [ASTM C 387, Type [M] [_____]] [ASTM C 270, Type [S] [_____]].

2.3.2 Brick and Mortar

Brick shall conform to [ASTM C 32, Grade [_____]] [_____].

Brick Mortar shall conform to [ASTM C 387, Type [_____]] [ASTM C 270, Type [_____]].

2.4 CONDUIT PIPING, JOINTS, FITTINGS AND GASKETS

2.4.1 Cast-Iron Soil Pipe (CISP) and Fittings

Pipe and fittings shall be in accordance with ASTM A 74, [service] [extra heavy] weight, with bell and spigot ends.

2.4.2 Cast-Iron Soil Pipe Joints

Joints shall be in accordance with AWWA C111 push-on type.

Gaskets shall be in accordance with ASTM C 564, [neoprene] [_____] type.

2.4.3 Ductile-Iron Pipe and Fittings

Pipe shall be in accordance with ASTM A 746.

Fittings shall be in accordance with AWWA C110 for 3 to 48 inch DN75 to DN1220.

2.4.4 Ductile-Iron Pipe Joints

Joints shall be in accordance with AWWA C111, [mechanical joint] [push-on] type.

Gaskets shall be in accordance with ASTM C 564, [neoprene] [_____] type.

2.4.5 Corrugated [Steel Pipe (CMP)] [Aluminum Pipe (CAP)]

Lifting lugs or markings shall be provided for placement of factory elongated corrugated pipe.

2.4.5.1 Metallic-Coated Corrugated Steel Pipe

Pipe shall be in accordance with ASTM A 760, Type [_____] Pipe shall be [lined] [unlined] steel having [annular] [helical] corrugations.

Corrugations shall be [_____] by [_____] inch millimeter.

Pipe shall be [aluminum] [zinc] [or] [aluminum-zinc alloy]-coated.

[Liner sheet thickness shall be [_____] inch millimeter.]

[Perforations shall be class [_____] .]

2.4.5.2 Polymer Precoated Corrugated Steel Pipe

Pipe shall be in accordance with ASTM A 762, Type [_____] .

Pipe shall be [lined] [unlined] steel having [annular] [helical] corrugations.

Pipe shall be [zinc] [aluminum] [or] [aluminum-zinc alloy]-coated.

Corrugations shall be [_____] by [_____] inch millimeter.

Polymer pre-coating shall be grade [_____] .

[Liner sheet thickness shall be [_____] inch millimeter.]

[Perforations shall be class [_____] .]

2.4.5.3 Corrugated Aluminum Pipe

Pipe shall be in accordance with ASTM B 745/B 745M, Type [_____] . Pipe shall be [lined] [unlined] aluminum having [annular] [helical] corrugations.

Corrugations shall be [_____] by [_____] inch millimeter.

[Liner sheet thickness shall be [_____] inch millimeter.]

[Perforations shall be class [_____]..]

2.4.5.4 Metal Pipe Fittings

Pipe fittings of same type and class as pipe material shall be provided. Fittings shall be sized and shaped to match conduit corrugations.

2.4.5.5 Gaskets and Coupling Bands

Gaskets and coupling bands shall be provided.

[Coupling bands shall be bituminous-coated to a minimum thickness of [0.05] inch [1.27] millimeter [_____]..]

[Coupling bands for polymer precoated pipe shall have [the same polymer precoating as the pipe] [bituminous coating] [the same metallic coating as the pipe] only.]

2.4.6 Concrete Pipe

2.4.6.1 Nonreinforced Concrete Pipe and Fittings

Pipe shall be in accordance with ASTM C 14 ASTM C 14M Class [1] [_____] [bell and spigot] [_____] ends.

Acceptability shall be in accordance with ASTM C 14 ASTM C 14M [strength] [_____] requirements.

2.4.6.2 Reinforced Concrete Pipe (RCP)

Round RCP shall conform to ASTM C 76 ASTM C 76M, be of Class [_____] , with wall type [_____] and with [wire fabric] [_____] reinforcement and [bell and spigot] [_____] ends.

Lifting holes shall be provided when using elliptical reinforcement.

Acceptability shall be in accordance with ASTM A 746.

Elliptical RCP shall conform to ASTM C 507 ASTM C 507M, and be of the [Horizontal] [Vertical] type, and Class [_____] with [wire fabric] [_____] reinforcement, and [bell and spigot] [_____] ends.

Lifting holes shall be provided.

Acceptability shall be in accordance with ASTM C 507 ASTM C 507M.

Arch RCP shall be in accordance with ASTM C 506 ASTM C 506M be of Class [_____] , with [wire fabric] [_____] reinforcement, and [bell and spigot] [_____] ends.

Lifting holes shall be provided.

Acceptability shall be in accordance with ASTM C 507 ASTM C 507M.

2.4.6.3 Reinforced Concrete Pressure Pipe (RCPP)

Pipe shall be in accordance with ASTM C 361 ASTM C 361M, be of Class [____], [Wire fabric] [____] reinforcement, and [bell and spigot] [____] pipe end joints.

Lifting holes shall be provided when elliptical reinforcement is used.

2.4.6.4 Gaskets

Gaskets shall be in accordance with ASTM C 443 ASTM C 443M [except Shore A durometer hardness shall be 40 to 55].

2.4.6.5 Joint Mortar

Mortar shall be in accordance with ASTM C 270 for each pipe joint and connection.

2.4.7 Vitrified Clay Pipe (VCP)

Pipe shall be in accordance with ASTM C 700, [extra] [standard] strength [perforated] with [bell and spigot] [____] ends.

Compression Joints shall be in accordance with ASTM C 425.

2.4.8 Plastic Piping

2.4.8.1 Acrylonitrile-Butadene-Styrene (ABS) Composite Pipe

Pipe and fittings shall be in accordance with ASTM D 2680.

2.4.8.2 ABS Composite Pipe Joints

Solvent cement and primer shall be in accordance with ASTM D 2680.

2.4.8.3 Type PSM Poly(Vinyl Chloride) (PVC) Pipe

Pipe shall be in accordance with ASTM D 3034, SDR [35] [____], up to 15 inch DN375 diameter.

Pipe ends made for joints shall be [elastomeric gasket] [solvent cement] type.

PSM PVC Pipe, 18 to 48 inch 450 to 1200 millimeter diameter shall be in accordance with ASTM F 794.

2.4.8.4 PVC Pipe Joints

Joints shall be in accordance with ASTM D 3212, [push-on] [mechanical joint] type.

[Gaskets shall be in accordance with ASTM F 477].

[Solvent cement shall be in accordance with ASTM D 2855].

2.5 FRAMES, COVERS AND GRATINGS

Manhole, catch-basin, and sump frames, covers, and gratings shall be in accordance with FS RR-F-621 AASHTO M 306.

[Cast iron] [_____] materials shall be provided. The following legends shall be cast-in on every cover: [STORM] [_____]. Cast iron shall conform to ASTM A 48 ASTM A 48M, Class 30B, minimum.

2.5.1 Manhole Frames [, Covers] [, and Gratings]

Frames shall be Type [I] [_____] , Style [A],[_____] , Size [_____].

Covers shall be Type [A] [_____] , Size [_____].

[Gratings shall be Type F, Style [1] [_____] , Size [_____].]

2.5.2 Catch-Basin Frames and Gratings

Frames shall be Type VI [_____] , Size [_____].

Gratings shall be Type G, Style [1] [], Size [_____].

2.5.3 Sump Frame and Grating

Frame shall be Type VII [_____] .

Grating shall be Type I [_____] .

2.6 PRECAST CONCRETE MANHOLES, RISERS AND PRECAST CONCRETE BASE SECTIONS

Concrete manholes, risers, base sections, and tops shall be pre-cast and conform to ASTM C 478. ASTM C 478M.

Precast parts shall contain [wire fabric] [_____] reinforcement.

Risers and grade rings shall be of the [_____] type.

Base sections shall be of the [_____] type.

[Acceptability for tops shall be based upon [proof of design testing] [_____].]

2.6.1 Manhole Gaskets

Gaskets shall be in accordance with ASTM C 443 ASTM C 443M for joints between manhole sections.

2.6.2 Manhole Connectors

Connectors shall be in accordance with ASTM C 923 ASTM C 923M for joints between manhole and pipes.

2.7 MANHOLE AND CATCH-BASIN ACCESS [STEPS] [LADDER]

Access shall be in accordance with [ASTM C 478] [ASTM C 478M], using [steps] [ladders] for manholes or catch basins at least [four] feet [1200] millimeter [_____] deep.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

Excavation, backfill, and removal of unsatisfactory materials shall be in accordance with Section [02312 EXCAVATION, BACKFILLING, AND COMPACTING FOR UTILITIES.] [02311 EXCAVATING, BACKFILLING, AND COMPACTING FOR STRUCTURES.]

3.2 GRADING

Grading shall be performed in accordance with Section 02315 EXCAVATION AND FILL.

3.3 PIPE INSTALLATION

3.3.1 Pipe Installation

Excavations shall be trimmed to required elevations. Objects which impair backfilling or compaction shall be removed. Over-excavation shall be corrected with [fill material of [fine] [coarse] aggregate.] [lean concrete.]

Pipe and fittings shall be inspected for defects before installing. Defective materials shall be removed from site.

Pipe interior shall be cleaned before installation. Pipe ends shall be sealed when work is not in progress.

Pipe shall be laid to line and grade, with bell end upstream.

[Maximum variation from true slope shall not exceed [1/8] inch [3.2] millimeter [_____] in [10] feet [3048] millimeter [_____.]

[Maximum deviation from design elevation shall not exceed [0.04] feet [12.2] millimeter [_____] at any point in the system.]

Maximum deviation from true line shall not exceed [0.20] feet [6.1] millimeter [_____] for pipe [15] inches [DN375] [_____] in diameter and smaller, [0.40] feet [12.2] millimeter [_____] for pipe larger than [15] inches [DN375] [_____] in diameter.

[Corrections shall be made at a rate not to exceed [0.10] foot [30.5] millimeter [_____] for one length of conduit].

3.3.2 [Cast-Iron] [and] [Ductile-Iron] Pipe Installation

Install [cast iron] [and] [ductile iron] pipe and fittings in accordance with manufacturer's instructions. [Mechanical joints shall be assembled in accordance with AWWA C111, Appendix A.]

3.3.3 Corrugated Metal Pipe Installation

[Corrugated steel] [and] [Corrugated aluminum] pipe with fittings shall be installed in accordance with manufacturer's instructions, and in accordance with ASTM A 798.

3.3.4 Reinforced Concrete Pipe Installation

Reinforced concrete pipe and fittings shall be installed in accordance with manufacturer's instructions, and ACPA 01-103.

3.3.5 Vitrified Clay Pipe Installation

Clay pipe and fittings shall be installed in accordance with manufacturer's instructions and in accordance with ASTM C 12.

3.3.6 ABS Composite Plastic Pipe Installation

ABS Composite plastic pipe and fittings shall be installed in accordance with manufacturer's instructions.

3.3.7 PVC Plastic Pipe Installation

PVC pipe and fittings shall be installed in accordance with manufacturer's instructions and in accordance with ASTM D 2321.

3.4 PIPE BEDDING

3.4.1 Bedding

Minimum compacted bedding under installed pipe shall be one-fourth of the pipe diameter in thickness, and in no case less than [4] inches [100] millimeter [_____] or more than [12] inches [300] millimeter [_____].

Bedding shall be placed in layers not exceeding 6 inches 150 millimeter in depth and compacted. Additional layers shall be added until a minimum elevation of [12] inches [300] millimeter [_____] above the pipe is achieved.

3.4.2 Trench Pipe Cradle

Trench pipe cradle shall be constructed monolithically of [3000 psi 21 Megapascal, air-entrained] [_____] concrete.

3.4.3 Concrete Encasement

Pipe shall be encased in [3000 psi] [21] Megapascal air-entrained [_____]

concrete to a level of not less than [6] inches [150] millimeter [_____] above the top of pipe.

3.4.4 Compaction

Puddling or jetting shall not be permitted when compacting bedding materials.

3.5 JACKING PIPE

Jacking pipe shall [not] be used.

3.6 UNDERGROUND STRUCTURES

3.6.1 Structures

[1/2]-inch [13] millimeter [_____] thick ASTM C 387, Type M mortar shall be applied to both interior and exterior surfaces.

Top of manhole and catch basin covers shall be set flush with finished pavement surfaces. Elsewhere, tops shall be set [3] inches [75] millimeter [_____] above finished surface.

Attach steps into manhole walls with [epoxy compound] [_____].

Preformed bituminous expansion joint material shall be provided [3/4] inch 19 millimeter [_____] thickness around drainage structures in pavements.

Joints for concrete risers and tops shall be [bedded in mortar and smoothed to uniform surface on both interior and exterior of structure] [made with flexible watertight rubber-type gaskets].

Catch basins and curb drop inlets shall be constructed.

3.6.2 Concrete Construction

Concrete shall be in accordance with Section 03300 CAST-IN-PLACE CONCRETE (SHORT SECTION).

3.6.3 Invert Channel Installation

Invert channels shall be smooth and fitted to each inlet, outlet, or transition for correct hydraulic flow.

3.7 STORM SEWER CONNECTIONS AND WYES

Pipe connections to existing conduit and manholes shall be provided.

Wyes for branch connections shall be provided. Field-cutting into conduit shall not be permitted. Wyes shall be sprung into existing lines. Entire wye shall be encased in concrete.

Epoxy shall be used to secure each interface connecting new and existing conduit.

3.8 FIELD QUALITY CONTROL

3.8.1 Tests

Contractor shall provide test equipment or engage the services of a firm to provide the necessary testing.

3.8.1.1 Infiltration Test/Exfiltration Test

[Infiltration] [and] [exfiltration] tests for installed concrete pipe shall be performed in accordance with ASTM C 969 ASTM C 969M.

3.8.1.2 Hydrostatic Test on Watertight Joints

Hydrostatic tests shall be upon one sample for each type of joint to be installed. When the sample joint fails, an additional joint of the same type shall be re-tested.

Joints shall be protected from temperatures which adversely affect the joining materials.

Test results for concrete pipe shall conform to [ASTM C 443] [ASTM C 443M] [AASHTO M 198].

Hydrostatic Pressure tests shall be performed at a pressure of 10 pounds per square inch (psi) 69 kilopascal for 24 hours. Cement or corrugated-metal pipes joined straight shall withstand 10 psi 69 kilopascal for 24 hours without failure. When test is completed test sections shall be angled and retested at 10 psi 69 kilopascal for an additional 24 hours.

Test results for clay pipe shall conform to ASTM C 425.

3.8.1.3 Low Pressure Air Test of Conduit

Acceptance tests for installed ferrous and plastic piping shall be in accordance with ASTM F 1417.

3.8.2 Interior Inspection of Pipe

Installed pipe shall be inspected [when 2 feet 600 millimeter of earth cover is in place] [and] [upon completion of project]. Displaced or misaligned pipe, infiltration, accumulation of debris, or other defects shall be corrected by the Contractor at no additional cost to the Government.

-- End of Section --